Amendments to the Specification:

On page 1, below the title and above "TECHNICAL FIELD", please insert the following new paragraph:

--This application is the United States national phase application of International Application PCT/JP2003/011882 filed September 18, 2003.—

On page 1, please replace the first full paragraph with the following amended paragraph:

The present invention relates to a quartz crystal substrate which is used to form a ~~phase-transition type~~ twin in a quartz crystal by a hot pressing method, and a pressing apparatus which is used to form a ~~phase-transition type~~ twin in a quartz crystal by a hot pressing method, and which is suitable for manufacturing the quartz crystal substrate described above.

Please replace the last paragraph on page 1 which continues to the top of page 2 with the following amended paragraph:

A quasi-phase matched wavelength conversion optical element has been proposed in which a periodic polarization inversion structure is realized by

applying a stress to quartz crystal (SiO_2), which is a paraelectric material, in the vicinity of the α-β phase transition temperature, so that a periodic twin structure is created (S. Kurimura, R. Batchko, J. Mansell, R. Route, M. Fejer and R. Byer: 1998 Spring Meeting of the Japan Society of Applied Physics Proceedings 28a-SG-18). This is a method in which a quasi-phase matched crystal based on quartz is manufactured by utilizing the ~~Dauphine~~ twin crystal of quartz to achieve a periodic inversion of the sign of the nonlinear optical constant d_{11}, and this quasi-phase matched crystal is used as the quasi-phase matched wavelength conversion optical element.

On page 2, please replace the first full paragraph with the following amended paragraph:

In the case of quartz, the short absorption edge is a wavelength of approximately 150 nm, and ultraviolet absorption at wavelengths shorter than 200 nm is almost negligible compared to the case of nonlinear optical elements using conventional birefringence phase matching (β-BaB_2O_4 and $CsLiB_6O_{10}$, etc.) or nonlinear optical elements using the quasi-phase matching of ferroelectric materials ($LiNbO_3$ and

$LiTaO_3$, etc.). Furthermore, this also has the following special feature not seen in conventional nonlinear optical elements: namely, there is a possibility of generating, with a high efficiency, light with a wavelength of approximately 193 nm, which is comparable to the light of an ArF excimer laser, by second harmonic generation. By setting the period at several microns to several tens of microns, it is possible to use the twin structure as a practical wavelength conversion device. A semiconductor exposure apparatus using this quasi-phase matched quartz crystal has been proposed (Japanese Patent Application Kokai No. H2002-122898.

Please replace the last paragraph on page 2 which continues to the top of page 3 with the following amended paragraph:

Initially, a method in which a periodic Cr film is formed on the surface of a quartz crystal substrate using lithographic and thin film formation techniques, and the temperature is elevated to around 550°C, so that ~~temperature and~~ thermally-induced stress ~~are~~ is applied utilizing the in-plane stress arising from the difference in linear thermal expansion coefficient

between the quartz crystal and Cr, was proposed as a method for manufacturing a periodic twin structure in a quartz crystal (S. Kurimura, R. Batchko, J. Mansell, R. Route, M. Fejer and R. Byer: 1998 Spring Meeting of the Japan Society of Applied Physics Proceedings 28a-SG-18). In this method, the crystal axes are inverted only in the portion where the Cr film is formed, so that a periodic twin structure is produced.

Please replace the last paragraph on page 3 which continues to the top of page 4 with the following amended paragraph:

The hot pressing method has been proposed as the method for solving such problems (S. Kurimura, I. Shoji, T. Taira, M. Fejer, Y. Uesu and H. Nakajima: 2000 Fall Meeting of the Japan Society of Applied Physics Proceedings 3a-Q-1). In this method, a periodic step structure is formed on the surface of one side of a quartz crystal substrate, this quartz crystal substrate is clamped between heater blocks from above and below, the temperature of the quartz crystal substrate is elevated, and pressure is applied at the point in time at which this temperature reaches a desired temperature. In this case, since stress

acts only on the portions corresponding to the protruding parts of the step structure, the crystal axis ~~components are~~ is inverted only in these portions. These portions with inverted crystal axes grow to the interior of the crystal and are thus propagated into the crystal, so that a periodic twin lattice that penetrates greatly in the direction of depth can be manufactured. Specifically, stress is concentrated only in the protruding portions, and twins are generated from these areas; these twins gradually grow into the interior, so that a twin structure with a large aspect ratio is manufactured.

Please replace the last paragraph on page 7 which continues to the top of page 8 with the following amended paragraph:

A combination of air pressure and hydraulic pressure is used to control the pressing load. Air at a pressure of several hundred MPa is supplied to an electrical air regulator 49 which can control the flow rate by means of voltage. A voltage from a ~~voltage generating device~~ function generator 50 that can generate arbitrary voltage patterns with respect to time is supplied to the electrical air regulator 49.

The air that is generated by this electrical air regulator 49 is supplied to a hydraulic pressure conversion amplifier 51. This hydraulic pressure conversion amplifier 51 has a 36-fold pressure amplification function. The hydraulic pressure of the hydraulic pressure conversion amplifier 51 is converted into a load by being supplied to the hydraulic cylinder 46, so that a maximum pressing load of approximately 10 kN can be obtained.

Please replace the last paragraph on page 13 which continues to the top of page 14 with the following amended paragraph:

Furthermore, in cases where a ~~phase-transition type~~ twin is formed in a quartz crystal using a conventional hot pressing method, the following problem arises: namely, as was described above, the work of forming a step structure on one side of the quartz crystal substrate using photolithographic and wet etching methods must be performed for each quartz crystal substrate.

On page 14, please replace the first full paragraph under the heading "DISCLOSURE OF THE INVENTION" with the following amended paragraph:

The first invention that is used to achieve the object described above is a quartz crystal substrate used to form a ~~phase transition type~~ twin in a quartz crystal by the hot pressing method, this quartz crystal substrate being characterized in that this substrate has, on one side, a step structure in which protruding parts that serve as pressure receiving surfaces for receiving the pressure of the pressing apparatus are formed, and this step structure is formed by a combination of a lithographic exposure technique and dry etching.

On page 15, please replace the second full paragraph with the following amended paragraph:

The second invention that is used to achieve the object described above is a pressing apparatus used to form a ~~phase transition type~~ twin in a quartz crystal by the hot pressing method, this pressing apparatus being characterized in that one of the pressing surfaces is held on the main body of the pressing apparatus via a swinging mechanism.

On page 16, please replace the second full paragraph with the following amended paragraph:

The third invention that is used to achieve the object described above is a pressing apparatus used to form a ~~phase-transition-type~~ twin in a quartz crystal by the hot pressing method, this pressing apparatus being characterized in that the apparatus has heater blocks, and pressing members that are constructed from a different material from the material of these heater blocks are attached to these heater blocks.

On page 18, please replace the second full paragraph with the following amended paragraph:

In this invention, since protruding parts are disposed on the side of the pressing member, it is necessary merely to polish the surface of the quartz crystal substrate; even if a step structure is not formed, the portions of the quartz crystal substrate that contact the protruding parts of the pressing member and are pressed by these protruding parts will undergo twinning, so that a ~~phase-transition-type~~ twin is formed. Accordingly, there is no need for a process in which a step structure is formed by

photolithography and wet etching for each quartz crystal substrate as in conventional methods.

Please replace the last paragraph on page 18 which continues to the top of page 19 with the following amended paragraph:

The fifth invention that is used to achieve the object described above is a pressing apparatus used to form a ~~phase-transition-type~~ twin in a quartz crystal by the hot pressing method, this pressing apparatus being characterized in that the apparatus has a heating mechanism in the pressing blocks, and this heating mechanism has a plurality of heaters.

On page 19, please replace the second full paragraph with the following amended paragraph:

The sixth invention that is used to achieve the object described above is a pressing apparatus used to form a ~~phase-transition-type~~ twin in a quartz crystal by the hot pressing method, this pressing apparatus being characterized in that air pressure alone is used to generate the pressing force.

On page 23, please replace the first full paragraph with the following amended paragraph:

Furthermore, in this working configuration, two heaters 18 which are used to heat the quartz crystal substrate 11 are installed in each of the heater blocks, i.e., the upper and lower heater blocks 14 and 16. These two heaters 18 have the same shape and heating capacity, and are disposed symmetrically on the left and right (in the figure) with respect to the center axes of the respective heater blocks 14 and 16 so that these heaters are located in positions that are equally distant from the pressing surfaces. Coil heaters are used as the heaters 18; however, it would also be possible to employ heaters using other means, e.g., ~~high-~~ radio frequency heating or heating by means of an electric furnace.

On page 25, please replace the first full paragraph with the following amended paragraph:

However, in cases where a ~~phase-transition-type~~ twin is formed in a quartz crystal substrate by such a method, a step structure must be formed by the process described above for each quartz crystal substrate. On the other hand, in the working configuration shown in

Figure 1, it would also be possible (for example) to devise the system so that a step structure which has periodic protruding parts is formed on the surface of the upper pressing plate instead of forming this surface as a flat surface, and a ~~phase transition type~~ twin is formed in the quartz crystal substrate by heating and pressing the quartz crystal substrate whose surface is polished to a flat surface. As a result, the process of step working for each quartz crystal substrate can be omitted.

On page 26, please replace the last full paragraph with the following amended paragraph:

In the working configuration shown in Figure 2, an air cylinder 25 is installed for the driving and pressing of the upper plate 21, and air at a pressure controlled by an electrical air regulator 26 is fed into the air cylinder 25. The electrical air regulator 26 is controlled by a ~~voltage generating device~~ function generator 28 via an electrical air regulator control device 27. A load gauge 29 is disposed between the upper plate 21 and the bearing block 20, and the output value of this gauge is input into the electrical air regulator 27. The electrical

air regulator control device 27 controls the electrical air regulator 26 so that an output of the load gauge 29 that is proportional to the voltage supplied from the ~~voltage-generating device~~ function generator 28 is obtained.

On page 27, please replace the second full paragraph with the following amended paragraph:

Furthermore, in this working configuration, an electrical air regulator control device 27 is provided which monitors an electrical signal from the load gauge 29 that is proportional to the load, and which performs a control action so that the load that is instructed by the ~~voltage-generating device~~ function generator 28 is applied. Accurate load application can be accomplished by means of this feedback control mechanism.